NOTES ON MONARDA FISTULOSA.

BY THOMAS MEEHAN.

As stated in the class-books, *Monarda fistulosa* is a variable species. A plant in my garden, originally from a shaded woodland in Eastern Pennsylvania, blooms from midsummer continuously till frost.

The midsummer heads are terminal. At the base of the common peduncle is a pair of leaves with two axillary buds. These make branches, and the earliest capitulum of the season stands regularly in the fork made by these branches.

But as these secondary branches grow and form pairs of opposite leaves, only one of the axillary buds in the lower pair pushes into growth. This one grows with so much vigor, that the capitulum is pushed to one side, the common peduncle becomes lateral, and the axillary branch becomes the leading stem.

At the next node the same behavior prevails, but at the third node both axillary buds develop, the strongest, however, assuming leadership.

The secondary branches of *Monarda fistulosa*, though apparently forming a straight stem, are formed of axillary branches, which, pushing aside the terminal common peduncles so as to make them lateral, have taken the position of the leading short or central axis. How this method of forming "extra axillary" inflorescence is brought about, I have explained in another paper.[1]

The flowers are centripetal. It takes several weeks from the time the central flowers of the capitulum open before those at the base follow. At this date, October 26th, the flowers begin to open by expanding the lobes of the corolla about sundown. Between 6 p. m. and 9 p. m. twelve had opened. By daylight next morning, in the head I had selected for observation, there were twenty-four. Rest follows, and nothing more is done in this direction till nightfall comes again.

The manner of opening is exceptionally interesting. It is well to examine a flower a day before it would naturally open. The long hair on the upper lip may be almost termed a beard. By lightly pulling this beard the flower bud is opened. The stamens are then seen lying flat on the lower lip, with the lower linear lobe of this

[1] Proceedings of Academy of Natural Sciences of Philadelphia, 1889, p. 58, "On Corydalis flavula."

lip turned inward on itself and pressed down on the anthers as closely as if these latter were in a vise. No pollen seems to have been ejected from the anther cells.

When the fulness of time arrives and the flower opens, the lips springing apart, the lower lip forms a tube and tightly enfolds the filaments. The expansion in different directions of the lips of the corolla is rapid. In less than one minute there will be a space of half an inch between them at their apices. The straightening of the filaments seems to be the chief motor in this movement. The effect is to draw the filaments wholly from the enfoldment of the lower lobe. The central lobe of the lower lip, which until this time has been pressed down on the anthers as already noted, rises at once when the upper lip has drawn them out, and assumes a vertical position. This is the last active effort. Rest then follows in all parts of the flower till next evening, when the little lobe takes another start and falls to a direct plane with the other portions of the lip.

The stamens in the bud are rather longer than the upper lobe of the corolla, while the pistil is rather shorter; hence when these are enfolded by the upper lip, only the upper portion of the stamens with the anthers, project beyond the apex of the lip. The anther sacs seem to burst simultaneously with the expansion of the lips, and while the whole pistil is enfolded by the incurved portion of the lip. It would seem that no pollen would reach the stigmas at this time.

At this juncture the picture is extremely beautiful. In all the force of expansion the anthers on the separate filaments continue connected by their lower filaments and become erect, looking, with a little play of the imagination, as if they had formed a blue basket, the pollen representing white flowers, the basket held up by the two arms over the head of an invisible cherub, as seen in some conventional pictures of a child with flowers. It is not till some time afterward that the divided apex of the pistil protrudes.

At night-fall the next day the stamens begin to wither. The anthers consist of two linear cells, end to end, and so close as to be almost confluent. These two cells do not shrivel simultaneously; the upper one goes first. As neighboring genera have but one cell, this little matter is of interest, as showing the connecting link. During the withering the viscid matter which caused the adherence of the pollen, seems to dry, and the pollen, probably still functionable, is distributed by the winds.

But what is the behavior of the pistil during all this time? It is wholly enfolded by the involute lobe of the lip, though in a few instances one of the style branches may slightly protrude at the apex of the lip; but the full growth and development is the work of another day. After the style has grown sufficiently to carry the branches beyond the apex of the lip, the branches expand, the larger branch curving backward and forming a complete circle. It takes about an hour to complete the circle.

I have utterly failed to form any conception as to how the flower effects fertilization. At the final drying up of the gelatinous pollen, when it is then distributed by the wind or insects, it would be possible for some to be carried to flowers with the exposed styles. But this would involve the later flowers in barrenness, which does not seem to be the case. Moreover the condition of the ova indicates that fertilization is effected in some earlier stage of anthesis; and the, so far as my examination now goes, unerring fertility of every flower, would lead one to suspect self pollination in some obscure way. Every one of 150 flowers in a single head was fertile. In grinding up these flowers with finger and thumb to get at the nutlets 183 perfect seeds were found. This showed that in some of the flowers the whole number of four seeds in each had not been perfected.

The results of my week of observation on this plant were so interesting and so puzzling that I was anxious to have the whole subject reviewed independently of any suggestions of my own. I gave some material to Dr. Ida A. Keller, a close observer in similar lines of study with myself, and the results of whose studies will appear in the following paper.